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AUTHOR Davenport, Linda Ruiz

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ABSTRACT

Homogeneous grouping of mathematics students, the practice of grouping students of similar ability or achievement, is most prevalent at the high school level, often occurs at the middle and junior high school levels in schools that offer algebra, and occurs at the elementary school level as part of general groupings. This digest summarizes research results on the long-term effects of this practice on mathematics education. Effects are reported in three categories: (1) opportunity to learn mathematics; (2) mathematics achievement; and (3) tracking practices. Results indicate inequities in access to strong mathematics programs, well-qualified teachers, and classroom opportunities for low-track students enrolled in schools that practice homogenous grouping. Studies indicate that homogeneous grouping, especially at the high school level, generally fails to increase learning and seems to widen gaps between students deemed to be more or less able. Research on tracking practices involving the effects on minority and female students indicates that these students are often placed in lower tracks, particularly at the secondary school level, a troubling result considering the low representation of female and minority students in science and mathematics areas. Contains 18 references. (MDH)

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The Effects of Homogeneous Groupings in Mathematics

Linda Ruiz Davenport

The practice of homogeneous grouping, which is quite widespread in the United States, uses a model that typically groups students together on ability or achievement as the deciding variable. At the high school level, this practice is most prevalent in mathematics, where students are placed in vocational, general, or college-preparatory mathematics courses (McPartland, Coldiron, & Braddock, 1987; Oakes, 1985, 1990a, 1990b; Slavin, 1990). It also occurs at the middle or junior high school level in those schools that offer algebra at the eighth grade. (McPartland, Coldiron, & Braddock, 1987; Oakes, 1985, 1990a, 1990b; Slavin, 1990). According to the Second International Math Study (SIMS), ability grouping is more extensive in the United States than any other country studied (Oakes, 1990a). Students at the elementary school level may also be tracked or grouped, although at this level students are more often grouped by general measures of ability or achievement rather than ability or achievement in mathematics (Oates, 1985, 1990a, 1990b; Slavin 1987a,1987b).

A second instance in which students are often homogeneously grouped is the small groups in classrooms where clusters are based on ability or achievement within that particular classroom. This has been an established practice for reading instruction at the elementary school level for years. Teachers frequently will organize their classrooms in a similar format for mathematics instruction (Oakes, 1990a; Slavin, 1987a, 1987b). The practice of placing small groups of students into high, medium, or low groups for mathematics instruction is less common at the middle, junior, or high school level where students tend to do less work in small groups and are sorted by the particular course (Slavin, 1990).

Such practices seem to stem from the widespread belief children's intellectual differences are so great that students with different ability or achievement levels need to be taught in separate classes or groups (Oakes, 1990a, 1990b). However, a number of concerns have been raised about the long-term effects of these grouping practices.

Effects on Opportunity to Learn Mathematics

In a National Science Foundation study of the way in which this nation's educational system provides opportunities to learn mathematics and sciences, cross-sectional data about mathematics and science programs, teachers, and classroom practices at the elementary and secondary school level were analyzed (Oakes, 1990a). These data were from the National Science Foundation's 1986 National Survey of Science and Mathematics Education (NSSME). While an analysis of these data showed important differences in opportunities to learn mathematics between schools, important differences were also found within schools. This seemed to be related to the practice of placing students into different tracks based on ability, achievement, or career expectations. The report identified three areas in which in inequities in mathematics instruction were found: (1) access to strong mathematics programs; (2) access to well-qualified mathematics teachers; and (3) access to classroom opportunities.

In most of the high schools described in the study, fewer mathematics courses were available or required for low-track students. Standard and advanced college-preparatory courses were offered to students perceived as having high ability, less often to students thought of as having average ability, and rarely to students seen as having low ability. Although some schools occasionally were willing to bend traditional placement criteria to encourage lower-achieving students to take more rigorous mathematics coursework. While it is true that tracking at earlier grade levels may limit the numbers of students eligible to take college-preparatory mathematics coursework, the end result is that many students are denied access to important mathematics experiences which prepares them to pursue the study of mathematics and science beyond high school. The study also found that schools often place their least qualified mathematics teachers in low-ability classes and their most-qualified teachers in their high-ability classes, particularly at the secondary level.

Finally, the study found that even when mathematics course titles are the same, the curricular goals emphasized by the teachers and the instructional strategies they employed to meet those goals differ in ways that lead to unequal opportunity to learn mathematics. For instance, it was found that high-ability groups at the elementary, middle, or junior and high school levels progress further in the school curriculum over the course of the year than low-ability groups. It was also found that lower-level courses expose students to fewer mathematical topics and skills as well as less-demanding topics and skills. High-ability tracks typically include more complex material and more difficult thinking and problem-solving tasks. In addition, teachers of high-track students reported spending more time preparing for class, and they appeared to be more enthusiastic and more willing to push their students to stretch academically than teachers of low-track students. Upper-track teachers also expected their students to spend more time on homework than did teachers of low-track students.

Similar qualitative differences in the mathematics instruction available to students in high- or low-track classes is born out in other research as well. For example, an examination of the middle school mathematics instruction in six different school districts found that in most districts a clear tracking hierarchy existed. Low-track students received a more limited curriculum and engaged in less favorable interactions with the teacher than did their high-track counterparts (Ekstrom & Villages, 1991). It is worth noting that even within the same classroom, differing patterns of interactions between teachers and high and low ability students have been found. With regard to mathematics instruction, a case study of one particular classroom showed that low-ability students received less teacher time and were asked a fewer number of process-oriented questions (Leder, 1987).

Effects on Mathematics Achievement

The NSF study described earlier (Oakes, 1990a) did not specifically examine the relationship between tracking and achievement in science or mathematics. However, a substantial body of research suggests that tracking, especially at secondary schools, generally fails to increase learning and has the unfortunate consequence of widening the achievement gaps between students judged to be more able or less able (Cole & Griffin, 1987; Eckstrom & Villegas, 1991; Gamoran & Berends, 1987; Slavin, 1987a, 1987b, 1990). Studies examining the effects of homogenous grouping on achievement tend to take two approaches: (1) comparisons of the achievement of students in heterogeneous classes with comparable students in ability-grouped classes or (2) comparisons of the achievement of students in different ability groups.

This distinction in the design of the research reported is an important one. Given the varying opportunities to learn mathematics in the different tracks one would clearly expect to find differences in mathematics achievement as a consequence. Therefore, it is not a surprise that achievement differences in mathematics due to tracking have been found even controlling for ability level, socioeconomic status, and a variety of other variables (Gamoran & Berends, 1987).

In reviews of research comparing the achievement of students in heterogeneous classes with comparable students in ability-grouped classes, few

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differences in achievement have been found. In particular, a meta-analysis of studies examining the effects of ability grouping on achievement of secondary students (middle,junior high, and high school) reported that in comparisons of ability grouping and heterogeneous grouping over periods of from one semester to five years, overall achievement effects were found to be essentially zero at all grade levels (Slavin, 1990). A similar meta-analysis for elementary students also showed that overall effects of ability grouping on achievement were negligible (Slavin, 1987b). Both meta-analyses refute the claim that ability group is good for high-achievers and bad for low-achievers which has often been asserted.

Interestingly, the only exception to these findings was when students from heterogeneously-grouped classrooms were regrouped homogeneously by reading and mathematics achievement scores for reading or mathematics instruction (Slavin, 1987a, 1987b). Here, the research has been inconclusive, with several studies of regrouping for mathematics instruction showing that homogeneous regrouping had positive effects on mathematics achievement when materials appropriate for the student's level of performance were used (Provus, 1960; Morris, 1969).

Effects of Research on Tracking Practices

In spite of the findings that homogeneous grouping seems to have little effect on achievement, some level of tracking persists in our public school system, particularly at the middle and high school level:

> While most people (including many educators) assume that students will learn better if they are grouped together with those who have similar capabilities, research has shown that putting children into separate classes to accommodate their differences from earliest school years is neither necessary nor very effective. Tracking does not work well for students in the low-and midde-ability groups, who experience and clear and consistent learning disadvantages. (Tracking does not necessarily promote achievement for high-ability children either. Many studies show that highly capable students do as well in mixed ability classes. (Oakes, 1990a, p. 5)

Oates has suggested that the persistence of tracking in the public school system is based on several assumptions: (1) that students learn better when they are grouped with other students who are considered to be academically similar; (2) that students develop more positive attitudes towards themselves and school when they are not placed in groups with others who are more capable; (3) that placement processes used to separate students into grouping both fairly and accurately reflects past achievement and native abilities; and (4) that it is perceived as easier for teachers to accommodate individual differences in homogeneous groups (Oakes,1985).

The persistence of homogeneous grouping is particularly troubling given the long-term effects on female and minority students, both groups of whom are dramatically underrepresented in the mathematics and science areas. The tendency to place minority students in lower tracks has been described by Cole and Griffin (1987) in their discussion of ability-grouping research:

> There have been many accounts of differential treatment in ability groups reported by researches who have examined classroom interactions closely...These researchers report that the *distribution* of students to high, middle, and low ability groups seems to be related to characteristics associated with SES: Children form low-income or one-parent households, or from families with an unemployed worker, are more likely to be assigned to low ability groups. The work by Cicourel and Kituse (1963) suggests that children from low income families with low grades and low test scores could be tracked higher, particularly because ofparental intervention. The more telling finding...is that children from low income families with adequate test scores and low grades were placed in lower group, while corresponding children from middle income families were placed in a middle level group. (p. 21)

Females, because they are sometimes seen as less able mathematically or because they express less interest in mathematics and science, may also be inappropriately placed in lower tracks, particularly at the secondary school level (Oakes, 1990b).

Recent assessments in mathematics achievement suggest students in the United States are not generally strong in mathematics, with too few students, especially minority and female, studying higher level mathematics. The reform literature in mathematics education argues strongly for the need of a quality mathematics education for *all* students. In their descriptions of exemplary classroom practice there is a strong focus on diversity of approaches (NCTM, 1989, 1991; RAC, 1989). Is it too much to hope that as school districts adopt approaches which are congruent with recent recommendations for mathematics education reform that the practice of homogeneous grouping will no longer be felt to be necessary?

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Linda Ruiz Davenport is an Assistant Professor of mathematics education at Portland State University.

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